Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

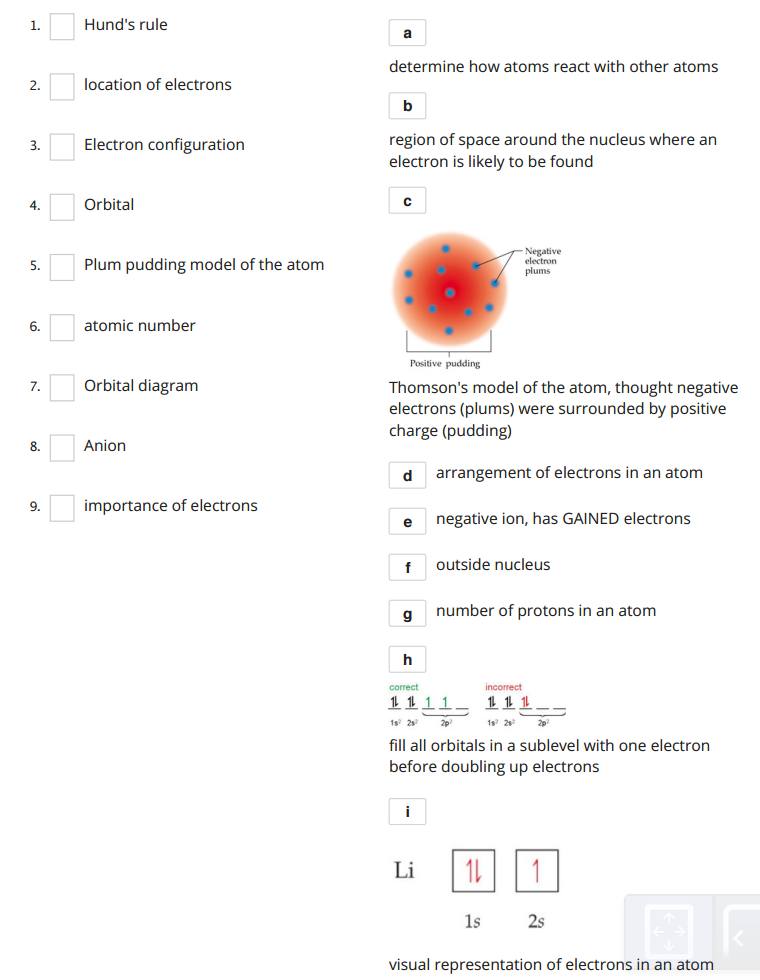
**Atomic Structure Problem Set**

*DIRECTIONS:*

*Complete this problem set in class. Finish it for homework if you run out of time in class. I will collect on Wednesday. I will miss you all today!*

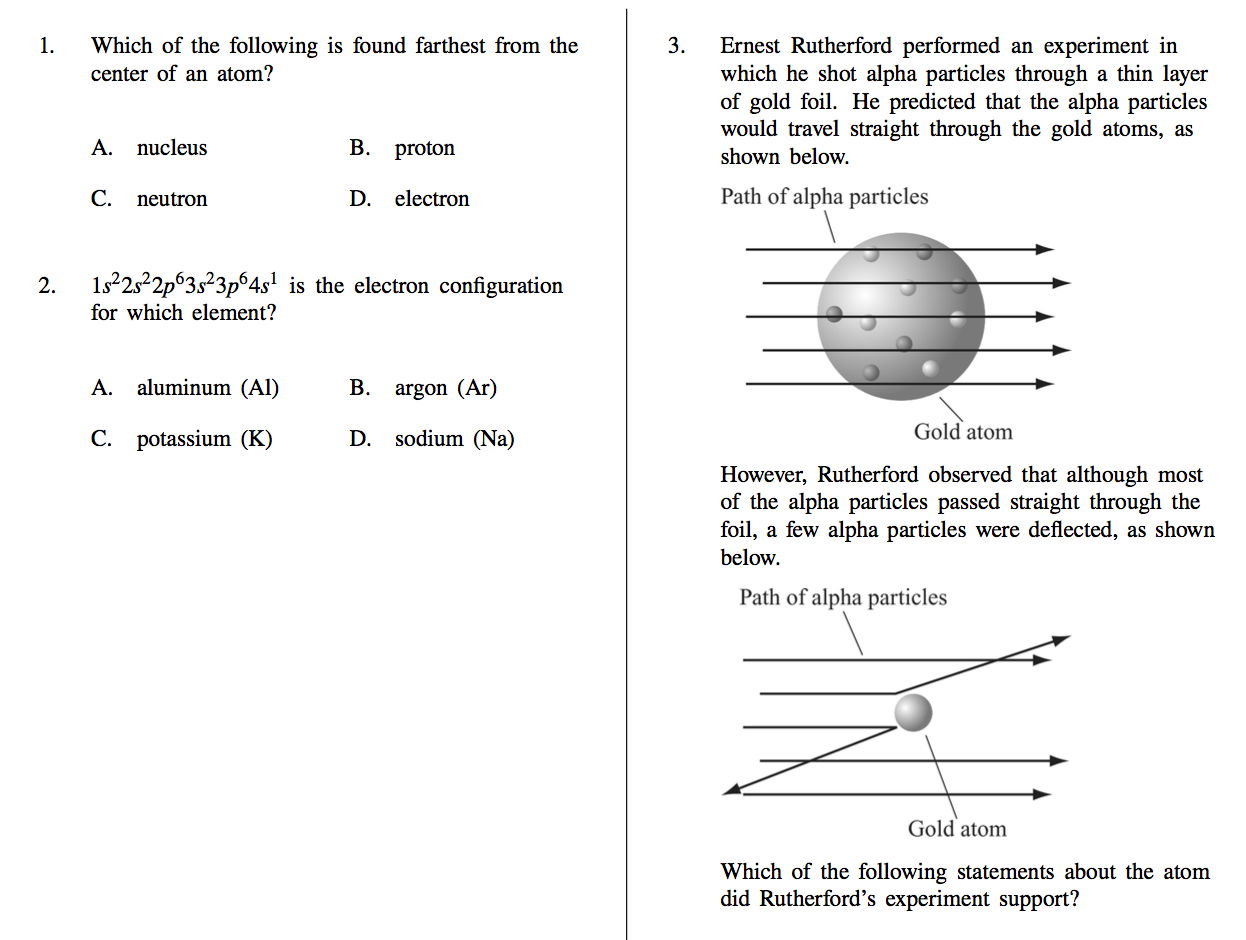
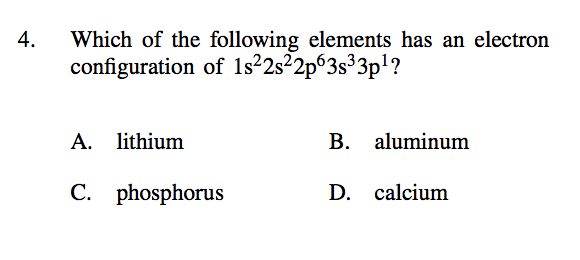
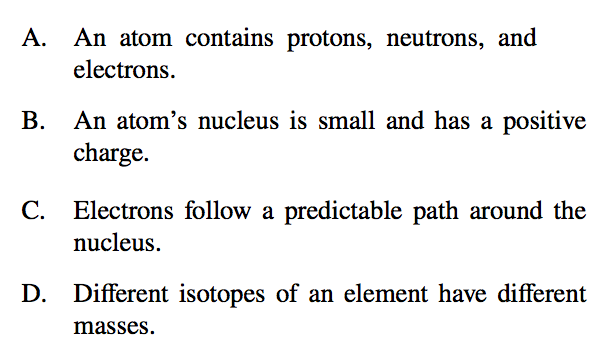
**Part 1: Matching**

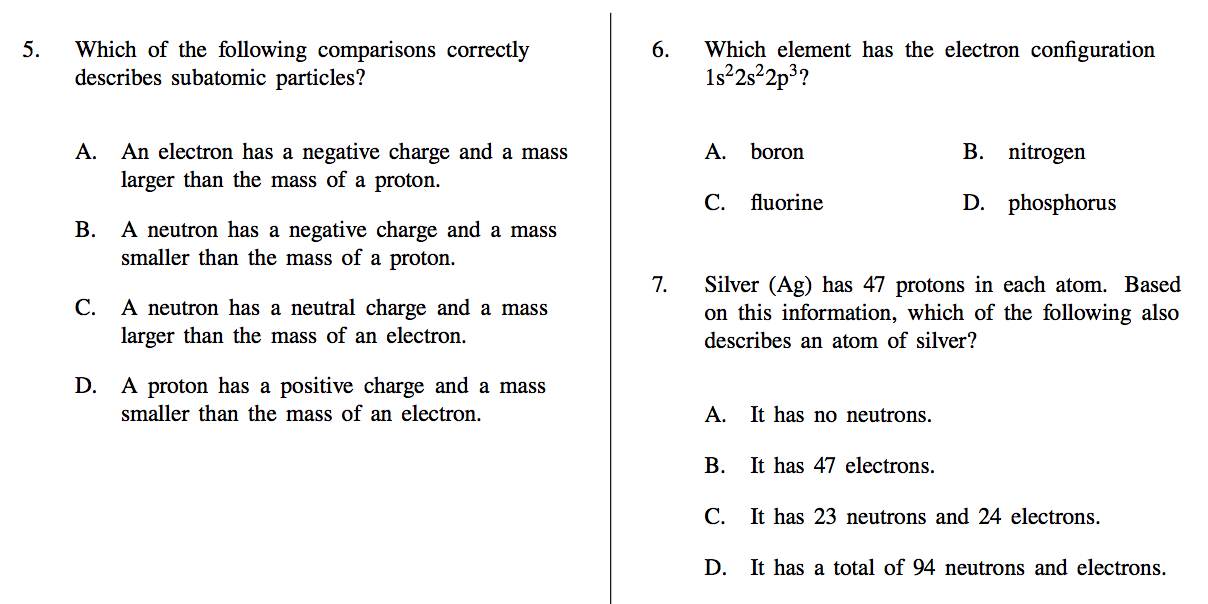
*Match each term on the left to its definition on the right.*



**Part 2: Multiple Choice**

*Choose the correct answer for each of the following questions.*





**Part 3: Fill in the Blank**

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are subatomic particles with a negative charge.
2. The nucleus of an atom is composed of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and protons.
3. A neutron has no charge, but its mass is essentially the same as that of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
4. The number of protons in an atom is called its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ number.
5. Isotopes of an element have different numbers of neutrons. They also have different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ masses.
6. The total number of neutrons in an atom of silver-109 (atomic number 47) is \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
7. The atomic mass of an element with 14 electrons and 16 neutrons is \_\_\_\_\_\_\_.

**Part 4: Calculations**

1. How many protons are found in an atom of each of the following?
   1. Boron \_\_\_\_\_\_\_\_\_\_\_ c. Neon \_\_\_\_\_\_\_\_\_\_\_
   2. Sulfur \_\_\_\_\_\_\_\_\_\_\_ d. Lithium \_\_\_\_\_\_\_\_\_\_\_
2. Complete the table for the following NEUTRAL elements.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Element | Number of Protons | Number of Electrons | Number of Neutrons | Atomic Number | Atomic Mass |
| Manganese | 25 |  | 30 |  |  |
| Sodium |  | 11 | 12 |  |  |
| Bromine | 35 |  | 45 |  |  |
| Yttrium |  |  |  | 39 | 89 |
| Arsenic |  | 33 |  |  | 75 |
| Actinium |  |  |  |  | 227 |

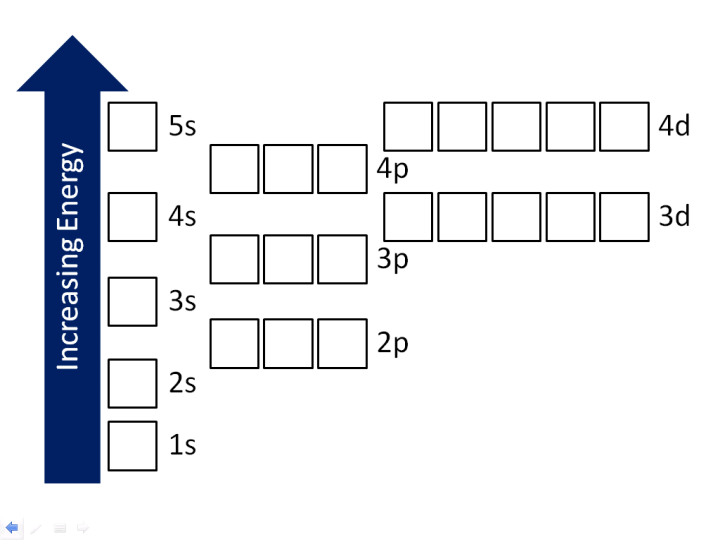
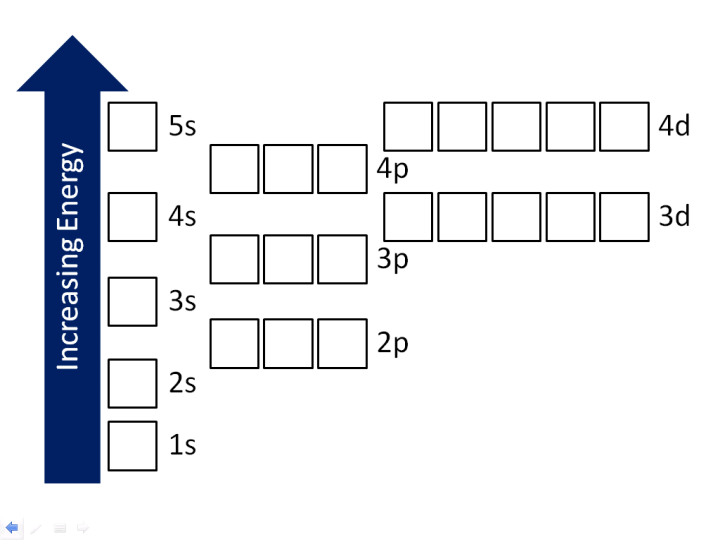
1. The two most abundant isotopes of carbon are carbon-12 (mass = 12.00 amu) and carbon-13 (mass = 13.00 amu). Their relative abundances are 98.9% and 1.10%, respectively. Calculate the atomic mass of carbon. Show your work!
2. The element copper has naturally occurring isotopes with mass numbers of 63 and 65. The relative abundance and atomic masses are 69.2% for a mass of 62.93amu and 30.8% for a mass of 64.93amu. Calculate the average atomic mass of copper. Show your work!
3. An atom has the following three isotopes: 24 amu (percent abundance = 78.99%), 25 amu (percent abundance = 10.00%), and 26 amu (percent abundance = 11.01%). Calculate the average atomic mass. What is the identity of this atom based on your calculation (compare to average atomic masses in the periodic table)? Show your work!

**Part 5: Electron Configuration and Quantum Numbers**

For questions 1-3, state which rule of electron configuration is being violated.

|  |  |  |
| --- | --- | --- |
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1. Draw the orbital diagrams for carbon (left) and bromine (right).



1. Write the full electron configuration for each of the elements below.
   1. Calcium: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Chlorine: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Iron: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write the four quantum numbers for each of the following elements.
   1. Helium \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Cobalt \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Osmium \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. Uranium \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   5. Rubidium \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   6. Selenium \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. The number of orbitals in a given subshell, such as the 5d subshell, is determined by the number of possible values of
   1. n
   2. ℓ
   3. mℓ
   4. ms
3. What are the possible values of n and mℓ for an electron in a 5d orbital?
   1. n = 1, 2, 3, 4, or 5 and mℓ = 2
   2. n = 1, 2, 3, 4, or 5 and mℓ = -2, -1, 0, +1, or +2
   3. n = 5 and mℓ = 2
   4. n = 5 and mℓ = -2, -1, 0, +1, or +2
4. How many electrons can a single orbital hold?
   1. 2n
   2. 2
   3. 2 + 1
   4. 8
5. Which of the following is not a valid set of quantum numbers?
   1. n = 2, ℓ = 1, mℓ = 0, and ms = -1/2
   2. n = 2, ℓ = 1, mℓ = -1, and ms = -1/2
   3. n = 3, ℓ = 0, mℓ = 0, and ms = 1/2
   4. n = 3, ℓ = 2, mℓ = 3, and ms = 1/2